Data Evaluation Record on the adsorption-desorption of fluensulfone in five soils

MRID Number 48574833

Data Requirement: OECD Guideline: 106
EPA Guideline: 835.1230

EPA PC Code: 050410
DP barcode: 403340

Test material: Fluensulfone

Primary Reviewer: Martin LeMay**,** PMRA

Secondary Reviewers: James Lin, US EPA **EPA Signature:**
Date: February 13, 2013

This study was reviewed as part of a global review. Therefore, the data evaluation was prepared in monograph form. This preface is a supplement to the attached monograph section and documents the review of the study for EFED.

Results Synopsis:
This study is classified as **acceptable**. (The same conclusion as PMRA)

CITATION: LaMar J. and Quistad G.B. (2011a) Soil Adsorption/Desorption of [^{14}C] Fluensulfone (MCW-2) by the Batch Equilibrium Method. Makhteshim Chemical Works, Ltd. Report No.: R23337, 20 MAY 2011 (MRID 48574833)

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Guideline: OECD Guideline No. 106
USEPA guideline 185.1230
Deviations: None

GLP: Yes (laboratory certified by US National Authority)

Executive Summary

The adsorption/desorption characteristics of [thiazole-^{14}C]-labeled 5-chloro-2-[3,4,4-trifluoro-(3-butene-1-yl) sulfonyl]thiazole were studies in a batch equilibrium experiment using four U.S. soils and one Canadian soil: a sandy clay loam [MSL-PF (North Dekota); pH 6, organic carbon 2.0%], a sandy loam [Ontario; pH 4.5, organic carbon 1.0%], a loamy sand [California; pH 6.2, organic carbon 0.40%], a sand [Texas; pH 5.7, organic carbon 0.55%], a loamy sand [Florida; pH 6.2, organic carbon 0.9%]. The adsorption phase was carried out by equilibrating air-dried soil with [^{14}C]fluensulfone at nominal concentrations of 0.01, 0.033, 0.10, 0.33 and 1.00 mg a.i./L for 24 hours at 20°C in the dark. The equilibrating solution used was 0.01 M $CaCl_2$ solution. The desorption phase of the study was carried out by replacing the adsorption solution with an equivalent volume of 0.01 M $CaCl_2$ solution and equilibrating for 24 hours.

The mean radiolabel carbon recoveries ranged from 87.0% to 96.2% (average 92.7% ± 6.0%). HPLC analysis of the desorption solutions for the 1.0 mg a.i/L samples indicated that [^{14}C]fluensulfone was stable in all soils tested in the study.

Following 24 hours of equilibration, an average of 50.8% of the applied radioactivity was adsorbed to the MSL-PF sandy clay loam soil, 44.4% to the Ontario sandy loam, 41.2% to the California loamy sand, 46.3% to the Texas sand, and 61.1% to the Florida loamy sand. Linear regression determined K_d values were 4.06, 1.54, 0.69, 0.87 and 2.47 for the MSL-PF sandy clay loam, Ontario sandy loam, California loamy sand, Texas sand and Florida loamy sand, respectively; corresponding K_{OC} values were 203, 154, 172, 157 and 275, respectively. Determined K_{FOC} values ranged from 151 to 251 (average K_{Foc} was 187 and 1/n was 0.95) indicating a moderate soil mobility for fluensulfone based on the ASTM classification system. A positive correlation between the K_d values and %OC of soils was observed. Therefore, the % organic carbon content of soils can potentially impact the amount of fluensulfone adsorbed. Following 24 hours of a single desorption cycle, the average percent of fluensulfone desorbed from the test soils, as percent of the radioactivity adsorbed, was 34.3%, 32.0%, 26.8%, 28.8% and 22.2% for the MSL-PF, Ontario, California, Texas and Florida soils, respectively. The reported Freundlich isotherm coefficients for the desorption ($K_{des\ FOC}$) ranged from 511 to 1058. According to the results of desorption cycle, the adsorption of fluensulfone is potentially reversible.

I. MATERIALS AND METHODS

A. Materials

1 Test Materials*:* [thiazole-4-^{14}C]fluensulfone

	Description:	Not given
	Lot/Batch:	Batch No. TJBIOS-NB21-33
	Purity:	Radiochemical Purity 97.3%
	CAS#:	--
	Stability of compound:	The test item was stable in the application solution during the treatment of the soil samples
2	**Soil:**	The soils were collected from specific locations. A summary of the physical and chemical properties of the soils is provided in **Table 1.**

Table 1: Soil Physiochemical Properties

Soil Name	MSL-PF		Ontario		California		Texas		Florida	
PTRL West Log #	1810W-033		2049W-001		2049W-002		2049W-003		2049W-004	
Percent Sand	63		58		82		87		86	
Percent Silt	16		31		15		12		7	
Percent Clay	21		11		3		1		7	
USDA Textural Class	Sandy Clay Loam		Sandy Loam		Loamy Sand		Sand		Loamy Sand	
% Organic Matter	3.4		1.7		0.69		0.95		1.5	
% Organic Carbon	2		1		0.4		0.55		0.9	
pH in 1:1 soil:water ratio	6.8		4.8		6.8		5.6		6.1	
pH in 0.01M $CaCl_2$	6		4.5		6.2		5.7		6.2	
Cation Exchange Capacity (meq/100cc)	17		7.7		4.6		3.9		5.3	
Moisture at 1/3 Bar (%)	21.9		12.4		4.8		3.9		5.6	
Bulk Density (disturbed) g/cm^3	1.02		1.2		1.43		1.38		1.29	
Base Saturation Data:										
Cation	%	ppm	%	ppm	%	ppm	%	ppm	%	ppm
Calcium	63.2	2152	26.6	410	59.3	545	48.8	379	46.2	487
Magnesium	20.4	417	6.6	62	15.2	84	10.9	51	6.8	43
Sodium	0.3	13	0.5	10	1.2	12	1.3	11	0.6	7
Potassium	3.8	253	3	91	3.4	62	4.1	62	3.9	79
Hydrogen	12.2	21	63.2	49	20.9	10	35	14	42.5	22

B. Study design

1. Experimental conditions

Preliminary trials for up to 72 hours demonstrated that a soil to solution ratio of 1:5 was optimal for MSL-PF sandy clay loam soil, while a soil to solution ratio of 1:2 was optimal for Ontario sandy loam and Florida loamy sand soils, and a soil to solution ratio of 1:1 was optimal for California loamy sand and Texas sand soils. Adsorption and desorption equilibration periods of 24 h were selected for the definitive study. Selected adsorption solutions were analyzed by HPLC.

The definitive experiment was conducted at 20 °C in the dark with dry-weight equivalent of soil as noted above. The study was conducted with 20 mL of 0.01 M aqueous calcium chloride, in 50 mL Teflon® centrifuge tubes. The samples were dosed with ^{14}C- fluensulfone dose solutions prepared in 0.01 M $CaCl_2$ at five final concentrations of approximately 1.0, 0.34, 0.1, 0.033 and 0.01 µg/mL (ppm). After dosing, the tubes were reciprocally shaken on a Wrist Action™ Shaker for 24 hr. The tubes were centrifuged at 4000 rpm for 30 min and the supernatants were decanted and radioassayed for radiolabel concentration. For desorption, the same volumes of fresh 0.01 M $CaCl_2$ solution were added to the samples and the tubes were shaken and processed as above. The 1st replicate desorption solutions from the 1.0 ppm rep A samples were analyzed by HPLC. Post-desorption soil samples were assayed for remaining radiolabel via combustion (3 x 0.2-0.3 g aliquots).

2. Description of analytical procedure

Radioactivity was determined by LSC and aqueous supernatants obtained after equilibration were analysed by reversed phase HPLC of the highest test concentration (1 µg/mL) samples. The limit of detection was calculated to be 0.0002 ppm based on the LSC measurement.

II. RESULTS AND DISCUSSION

A. Mass Balance

Radiocarbon recoveries for each sample were determined as the sum of the adsorption solutions, desorption solutions, and unextracted radiocarbon. The average radiocarbon recovery for the definitive experiment was 92.7 ± 6.0%. Recoveries for the control samples which contained no soil ranged from 93.7-98.4% of the dose indicating that the test substance did not adhere to the container walls during the course of the experiment.

B. Transformation of Parent Compound

No significant degradation was observed after 24 hours of adsorption in the supernatants. The desorption solution for the 1.0 ppm sample was analyzed by HPLC and ^{14}C- fluensulfone was shown to be stable. Fluensulfone was also stable in controls that contained no soil, representing 100% of the available radiocarbon.

C. Findings

Sorption parameters for both linear and Freudlich isotherms (Kd, Koc, KF, KFOC and 1/n) for the adsorption phase and desorption phase have been determined and reported in **Table 2**.

Table 2: Adsorption Characteristics of fluensulfone on Five Soils

Parameters		Soil					Mean
		MSL-PF	Ontario	California	Texas	Florida	
Texture		Sandy clay	Sandy loam	Loamy sand	Sand	Loamy sand	---
% Organic carbon		2.0	1.0	0.40	0.55	0.9	---
% Organic matter		3.4	1.7	0.69	0.95	1.5	---
pH ($CaCl_2$)		6	4.5	6.2	5.7	6.2	---
K_d	[mL/g]	4.064	1.535	0.687	0.865	2.472	**1.92**
K_{OC}	[mL/g]	203	154	172	157	275	**192**
K_{OM}	[mL/g]	120	90	100	91	165	**113**
K_F	[mL/g]	3.95	1.51	0.717	0.865	2.26	**1.86**
K_{FOC}	[mL/g]	198	151	179	157	251	**187**
K_{FOM}	[mL/g]	116	89	104	91	151	**110**
1/n	-	0.910	0.964	0.993	0.995	0.885	**0.949**
r^2	-	0.999	0.999	0.997	1.000	0.998	---
$K_{des, F}$	[mL/g]	10.21	6.83	4.23	3.69	5.48	**6.09**
$K_{des, FOC}$	[mL/g]	511	683	1058	671	608	**706**
$K_{des, FOM}$	[mL/g]	300	402	613	388	365	**414**
1/n	-	1.011	1.092	1.085	1.086	0.930	**1.041**
r^2	-	0.998	0.994	0.992	1.000	0.997	---

III. CONCLUSIONS

Fluensulfone is estimated to be moderately mobile in soil. The mean Freundlich isotherms coefficients K_{FOC} and $K_{des, FOC}$ were 187 and 706 mL/g, respectively.